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"The Legacy of the Lisa", Mac World, Sept. 1985.

"Large-Capacity Disks", H. Falk, Electronic Library, v8 n3 p209-11.

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The Legacy of the Lisa ,

Tesler, L.

Macworld, v2, n9, p17

Sept., 1985

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ABSTRACT: The author was manager of the 20-person Applications Software Group that helped develop the Macintosh XL, popularly known as Lisa. Production on Lisa ceased on April 29, 1985. The author expresses gratification for the changes in public expectations of personal computers brought about by Lisa, and goes on to reflect on them. The user interface, the most publicized feature of Lisa, incorporated ideas borrowed from others as well as in-house innovations. It was distinguished for its menu bar, the one-button mouse, the Clipboard, and the Trash can. The developmental history of Lisa is detailed. A complete table of Lisa innovations that were incorporated into the Macintosh is included.

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TRADE NAMES: Lisa

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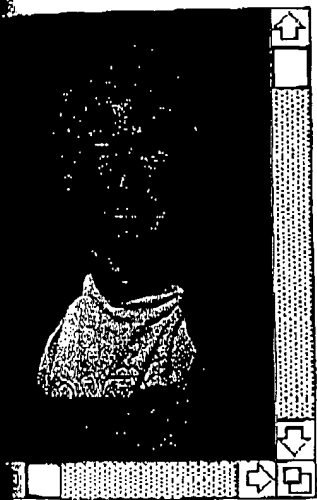
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Note Pad: Larry Tesler

The Legacy of the Lisa

A member of the Lisa development team reflects on how the Lisa changed personal computing



On April 29 Apple announced that it would cease production of the Macintosh XL computer, formerly known as the Lisa. As a member of the group that helped create the Lisa, I couldn't help but feel a pang when I heard the news. Yet my overriding feeling is one of gratification. In its brief product cycle, the Lisa changed people's expectations of a personal computer. Among Apple products, the Lisa spawned not only the Macintosh but also the MouseText option on the Apple II (see "The Lisa's Influence"). Even IBM PC products were heavily influenced by the technology, including VisiCorp's *Visi On*, Microsoft's *Windows*, Digital Research's *GEM*, Ashton Tait's *Framework*, and IBM's *TopView*.

The user interface was the most publicized characteristic of the Lisa. It introduced a host of ideas that have been widely emulated, ranging from how columns are widened in a spreadsheet to how people are notified of mistakes and problems. When the Lisa development team designed the user interface, we borrowed good ideas from wherever we could

find them. For example, the Lisa borrowed pop-up menus and overlapping windows from Smalltalk, status lines from *VisiCalc*, and automatic removal of extra spaces after text deletion from Douglas Engelbart's research at SRI International.

But the Lisa user interface was not a copy of any that preceded it; it was distinctive. It was the first to feature the now-familiar menu bar, the one-button mouse, the Clipboard, and the Trash can. Although the Xerox Star had icons, the Lisa was the first product to let you drag them with the mouse, open them by double-clicking, and watch them zoom into overlapping windows.

To minimize the time it would take people to learn to use the Lisa, Apple technical writers, programmers, and marketers struggled for two years to find suitable terminology to appear in menus, dialogs, alerts, and manuals. Our foreign-language translators spent months more choosing the corresponding terms in French, Italian, German, Spanish, and other languages.

It may come as a surprise that terms like *Revert*, *Plain Text*, *Align Left*, *Clipboard*, and *Panel* were difficult to coin and even more difficult to agree upon. When we studied *VisiCalc*, we discovered that people had trouble interpreting

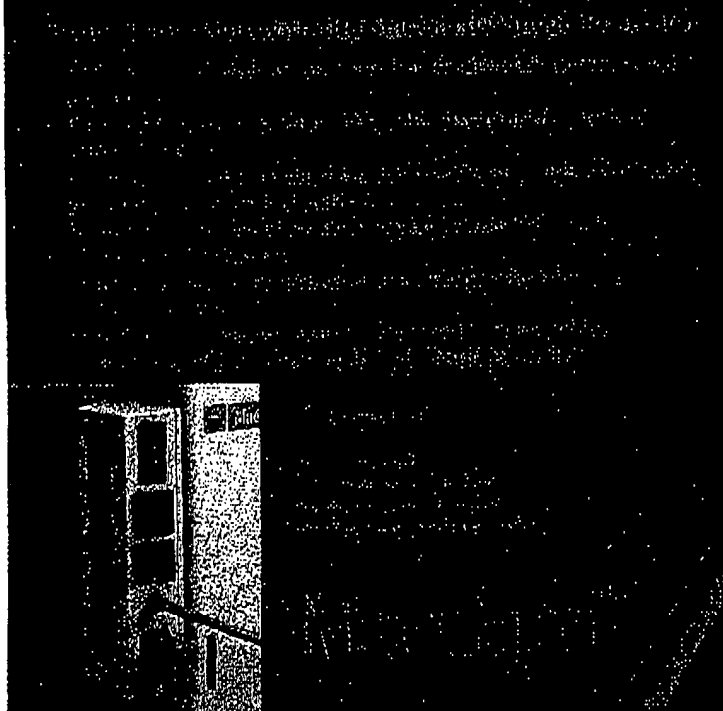
the term *General Format*, which means that a number typed into a spreadsheet cell is right justified, while text is left justified. After extensive brainstorming and testing of *LisaCalc*, we chose *Words left*, *numbers right*, which was self-explanatory if a bit verbose.

Much has been made of the high cost and five-year development time of the Lisa. True, the development was expensive, but it did not take five years. The first Lisa was shipped in May 1983. Five years earlier, in 1978, Apple had launched a project code-named "Lisa," but that project's goal was quite different from what the Lisa eventually became. In early 1980, after Apple's senior staff visited Xerox's Palo Alto Research Center (PARC) to see a demonstration of Smalltalk, the goal was completely redefined. Only the code name, some of the hardware components, and a few of the staff members stayed the same.

I was the PARC employee who gave Apple the Smalltalk demonstration. Impressed by the perspicacity of the visiting Apple staff members, I resolved to join their company, which I did in July 1980. Rich Page had just built the first Lisa prototype incorporating a sample 68000

Note Pad

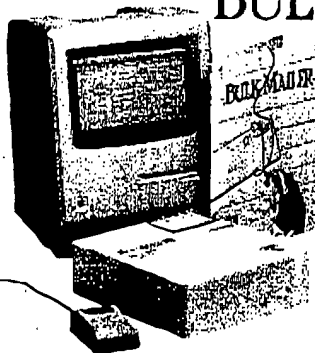
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microprocessor from Motorola. Apple's small but energetic Lisa development team was debating the relative merits of one-, two-, and three-button mice. No software had been designed except a tiny prototype of *LisaWrite* written on an Apple II. Some thought had been given to the user interface, but there was no menu bar, no icons, and only one scroll bar on the left side of each window.

In the summer of 1980, a group headed by Bill Atkinson and myself defined the ground rules of the user interface. Today those rules are familiar to anyone who uses a Macintosh or a Lisa. Bill prototyped pull-

down menus and a one-button mouse, along with alternatives to this scheme. I had a number of people use the prototypes to compare the relative merits of those designs.

That autumn Bruce Daniels hired most of the Software Group. Although the majority had never seen a mouse before, they plunged into the design of the operating system, the Window Manager, QuickDraw, *LisaCalc*, *LisaDraw*, *LisaGraph*, *LisaList*, and the Desktop Manager (Finder).

As manager of the 20-person Applications Software Group, I was pressured constantly for schedules and priorities. My associate, Peggie Stanford, tried a number of project scheduling

The Lisa's Influence

The Lisa affected the design of many personal computers. Listed here are Lisa innovations that were incorporated into the Macintosh.

Hardware

- Mouse design
- Imagewriter printer

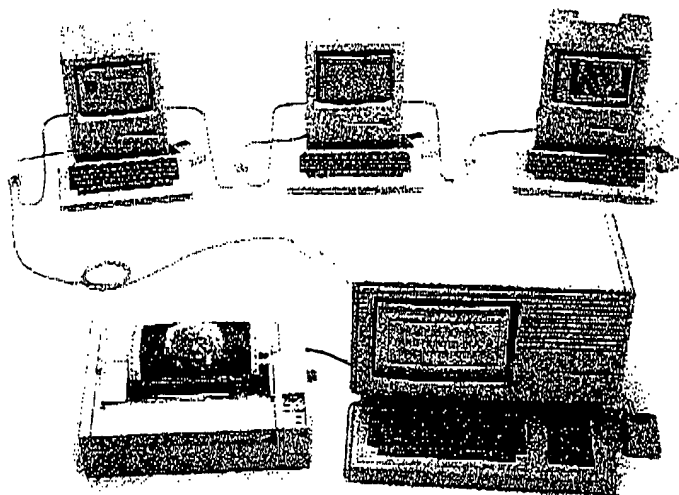
User Interface

- Menu bar, pull-down menus, keyboard-activated menu commands
- Printing dialog boxes
- Appearance, structure, and operation of windows and scroll bars
- Ability to move windows and icons by dragging them with the mouse
- Windows that zoom to open and close
- Dialog and alert boxes with buttons and check boxes for selecting choices

Individual Software Packages

- QuickDraw graphics are identical on the Lisa and the Macintosh.
- *LisaProject* was converted for Macintosh to become *MacProject*.
- *LisaDraw* was converted for Macintosh to become *MacDraw*.
- *LisaTerminal*, *LisaWrite*, *LisaCalc*, *LisaGraph*, and *LisaList* influenced the design of Macintosh applications.
- The Lisa Desktop Manager influenced the design of the Macintosh Finder.
- The Lisa printing software heavily influenced the Macintosh printer-driver equivalent.
- Lisa Pascal is still the principal language used to develop software for the Macintosh.

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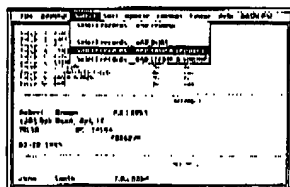
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Note Pad

programs, but none were satisfactory. One day, at a meeting of my staff, I described my dream scheduling system. Steve Young mentioned the concept to his wife, Debbie Willrett. She promptly quit her job at another computer company and in a few incredible weeks created the first prototype of *LisaProject*. We relied heavily on that program throughout the remainder of the development period. The marketing department was impressed by its utility and decided to make it a product.

One story that was exaggerated in books and articles was the tension between the Lisa and Macintosh teams. As in any friendly rivalry, some individuals took the competition too seriously. By and large, the teams gave each other both moral and technical support. Half the Macintosh programmers came from the Lisa group, and most of those were working on both Lisa and Macintosh tasks at the same time. We were saddened when the merger of our divisions forced the elimination of many duplicate and obsolete jobs, but most of the displaced employees found positions elsewhere in the company, and the rest discovered that Lisa developers are well-regarded in Silicon Valley.

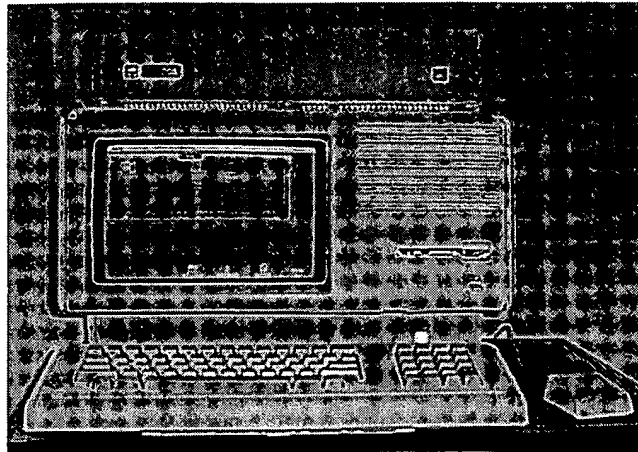
Newspapers and magazines like to feature stars, and as a result a few members of the Lisa team received the lion's share of the publicity and credit for the product. Everyone who worked on the Lisa knows that it was a team endeavor. My most lasting memory will be of how much everybody cared

about the quality of the product. Every 80-hour workweek, every canceled vacation, every hot debate, and every wrenching management decision was motivated by one common driving force: we wanted our product to be the best.

By my reckoning the Lisa engineering effort took three years from product definition and first prototype to full production. In the end we had produced the first multitasking windowing system for a personal computer. In my opinion the Lisa Office System still outclasses its IBM PC imitators more than two years after its first public demonstration.

I am sure that every former member of the Lisa Development Team is proud of our accomplishment. We put our hearts, minds, and lives into fulfilling a dream. Its role in the product line will be filled by the 512K Macintosh with a 20-megabyte hard disk and integrated applications. The Lisa manufacturing line may be closed, but the accomplishment lives on in the lower-cost, higher-performance Macintosh.

Larry Tesler continues at Apple Computer as manager of a group exploring software development methodology.



The Apple LISA 2/5

My favorite Apple computer. This is a really gorgeous case that holds some nifty hardware. The LISA (more commonly "Lisa", originally the code name. It is unclear whether it was after Steve Jobs' newly born daughter, or one of the engineer's daughters, but, later it was defined as Local Integrated Software Architecture) was introduced January 1983. In its first generation (LISA 1) it had 1Mb RAM (expandable to 2Mb), integrated B/W bit-mapped display (720 x 364 pixels), and dual 860K "twiggy" floppy drives. These drives were very thin (like the British singer Twiggy), but high density - 860K each. They did not survive long for two reasons: they could only use a special type of disk, and they were unreliable. I have never seen a LISA with its original "twiggy" drives installed (see picture below). The CPU is a Motorola 68000 @ 5Mhz. The machine also had one parallel port, two programmable serial ports, a B/W video out port, the mouse port, and 3 expansion slots. The first version of QuickDraw graphic primitives that are found in the Mac ROMs were in the LISA's ROMs. The machine was shipped with the OS (called the "Desktop Manager"), LisaDraw, LisaWrite, LisaCalc, LisaGraph, LisaGuide, LisaList and LisaProject. All of the software packages were integrated, meaning that one could share info between them (something we take for granted today, but a first at the time). The entire system with a 5Mb external hard drive cost \$9999.00, without tax. Two printers were available: the \$645 dot-matrix or a \$2165 Daisy Wheel.

The ProFile hard drive from the Apple III was standard. This was a 5Mb parallel drive. When one used the HDD, they needed to purchase a \$195.00 parallel card for one of the expansions slots (if you needed parallel ports). This card also allowed the use of more than one hard drive. Apple engineers had ease of service in mind when designing the LISA. All of the components can easily be removed, most without the use of tools.

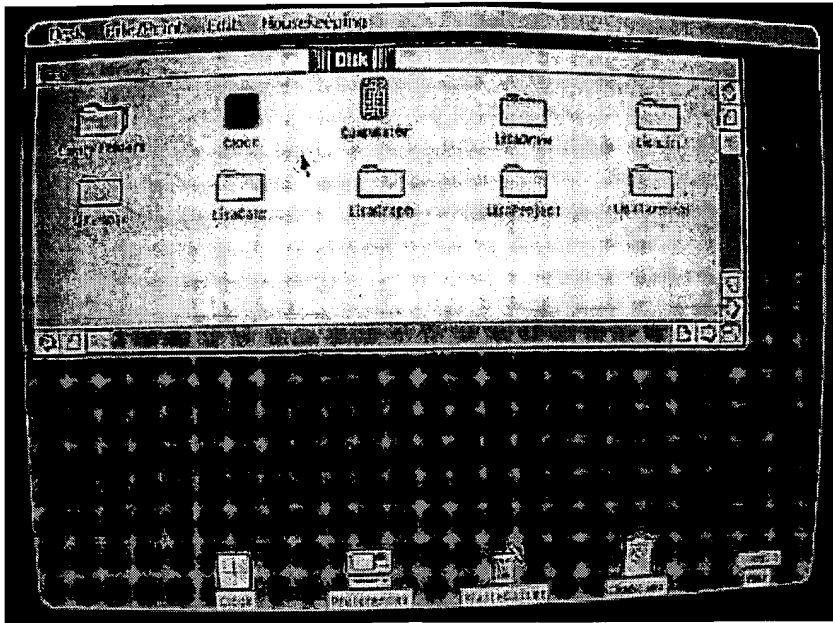
The LISA 2 is almost the same machine. Differences are: 512K RAM, no hard drive, 3.5" 400K floppy. Introduced in January 1984 (though less quietly than the Macintosh), the Lisa 2 was an attempt to realign the product and boost sales (only 11,000 LISA 1s were sold). The machine retained the high resolution display, but could also support text based OSs (UNIX/XENIX) on a 24 x 80 screen (not at the same time with the Lisa OS). The LISA (now Lisa) 2 could support 11 different operating systems: UNIX, XENIX, MacWorks, the WorkShop (software developing), Lisa 7/7, and Desktop Manager are the most common. Two hard drives were available, the ProFile 5Mb like the LISA 1's and an

internal 10Mb drive. Both were parallel drives, therefore the Lisa 2/10 (Lisa 2 with a 10Mb HDD) had no parallel port on the rear of the machine - an interface card was required. The Lisa 2 had no external floppy drive support as the Mac did, therefore using a Lisa 2 without the hard disk caused suicidal tendencies :-).

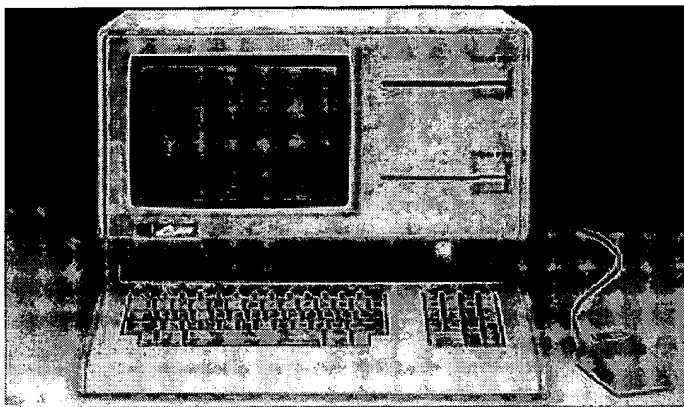
Unfortunately, none of this really helped sales, and the only users of the Lisas were people who wanted to impress their friends, and those who were developing Mac software (Apple used Lisas for the original Mac software and code - the Mac was not powerful enough). In 1984 Apple offered MacWorks. This was an OS that ran Macintosh software. It was actually the Mac ROMs and OS dumped into RAM (512K was 4 times that of the first Macs) and mapped such that the software would be tricked into believing it was on a Mac. This worked, but the Lisas had more pixels on its 10" screen than the Mac on its 8", so icons and graphics appeared taller than they really were. Later there was a conversion kit containing new screen ROMs that would make the Lisa's display look correct running MacWorks (see below). WYSIWYG was out the window. In January of 1985, Apple dubbed the remaining Lisa 2s as the Macintosh XL (X-tra Large? X-tra Lisas?). In April 1985, it discontinued the Lisa. The remaining were destroyed or sold off to Sun Remarketing (the only place for Lisa stuff today, if you are willing to pay for it). Rumor has it that Apple buried something like 5,000 machines and parts in a landfill due to a dispute with stock holders. A hell of a machine that lasted 3 1/2 years, but never did catch on.

The machine shown is a Lisa 2/5 with its Profile and 1MB RAM. The display is of the Lisa Desktop Manager - the Lisa 7/7 System Version 3.1.

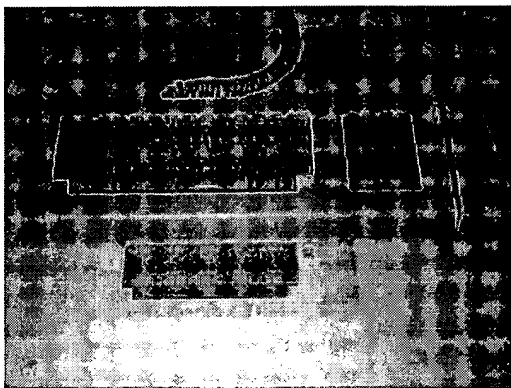
- Machine: Apple LISA, and Lisa 2/5 and Lisa 2/10
- Processor: Motorola 68000 @ 5Mhz
- RAM: 512K - 2Mb
- Display: 12" bit mapped, 720 x 364 pixels and 24 x 80 characters (Lisa 2)
- Storage: two 860K "twiggy" 5.25" floppy (LISA 1), one 400K 3.5" Sony floppy (Lisa 2), 5 Mb external HDD (Lisa 1 and Lisa 2/5), 10Mb internal HDD (Lisa 2/10)
- Expansion slots: 3
- Ports: two serial, one parallel (not on Lisa 2/10), B/W video out, mouse
- Operator Input: 76 key keyboard (58 character, 18 numeric keypad), mouse
- Cost (as shown): Lisa 1 = \$9999.00, Lisa 2 = \$3495.00 - \$5495.00+ (\$4495.00)
- Production: June 1982 - April 1985 (unknown # units)



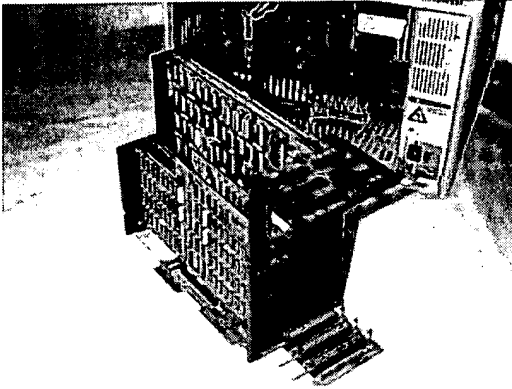
Close up of the Lisa Screen. The open window is contents of the hard disk. The screen is a bit fish-eyed because my camera is not good at this type of shot.



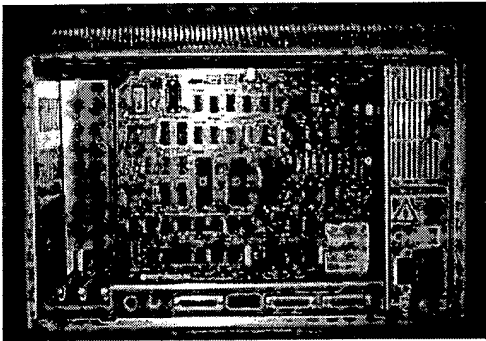
This shows the LISA 1 with the dual Twiggly drives. I have always felt this was one of the best looking machines to come out of Cupertino.



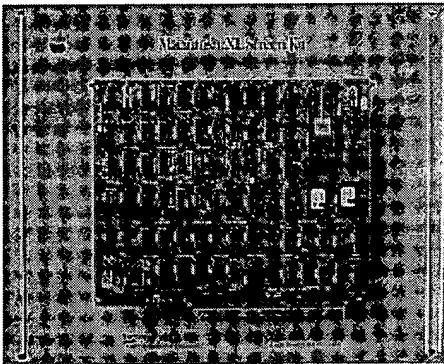
The keyboard has little help cards that pull out from under it.



The entire machine is modular. Here the card carrier has been pulled out. There is an I/O card, the CPU card, and two 512K memory cards.



The back has been removed to show the three expansion slots on the left. Also seen are (from left to right): the reset button, a video out port, parallel port, mouse port, two RS-232 serial ports, and the power supply.



The screen ROM kit that made the Mac OS look correct on the Lisa's display. No instructions are included - only an authorized technician was to install it.



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Apple's Twiggy Disks

In the early '80s, Apple fell victim to a serious case of NIH Syndrome (Not Invented Here), and decided to manufacture their own disk drives. Not content to be industry compatible, instead they designed what they believed to be leading-edge drives: the Twiggy floppy drive and the Widget hard drive.

The Twiggy floppy drive was a double-sided drive, but unlike conventional double-sided drives the heads were not directly opposing. Instead the heads were on opposite sides of the spindle, and opposing each head was a pressure pad (as commonly used in single-sided drives). This was supposed to reduce head wear. It also meant that the stiff jackets of the floppy media had to have non-standard cutouts. The write-protect cutout was moved to the side of the disk that would be nearest the back of the drive. One corner of the disk was notched for "keying" to prevent the user from inserting the disk incorrectly. A rectangular hole near that corner was apparently for use to latch the disk in the drive, preventing the user from removing it while it was in an inconsistent state.

Also, rather than spinning the disk at the then-standard 300 RPM, they adjusted the speed based on the cylinder being accessed, from 218 to 320 RPM. This allowed the storage of more sectors per track on the outer tracks, while using a roughly constant peak FCPI (flux changes per inch) on all tracks. Normal floppy disks use constant rotation and data rates, and effectively waste much of the storage capacity of the outer tracks. Modern hard disks vary the data rate and keep the rotation rate constant.

Note that since the heads were on opposite sides of the spindle, but moved by the same actuator mechanism, when one head is near the center the other is near the edge. Thus, it is not possible to rapidly switch sides of the media. For normal double-sided drives the optimum order is to read both sides of each cylinder before moving the positioner to the next track. On the Twiggy drive it was faster to read one entire side, then the other.

Apple used a track pitch of 62.5 TPI, rather than the standard 48 TPI or 96 TPI. I suspect that they were able to achieve 62.5 TPI using the same heads that would normally be used for 48 TPI, rather than the narrow-gap heads used for 96 TPI.

Through the use of double-sided media, the higher track pitch, variable motor speed, and GCR recording, Apple achieved a storage capacity of 871,424 byte per diskette, a six-fold improvement over the earlier single-sided Disk II and Disk III drives had a capacity of 143,360 bytes.

My experimentation indicates that media formulation was apparently similar if not identical to the media later adopted for "high-density" (1.2 MB) 5.25 inch drives (first commonly used in the IBM PC-AT). Before I acquired a supply of Twiggy diskettes for my Lisa 1, I made a few by very laboriously modifying 1.2 MB diskettes.

Apple trademarked the term "FileWare" to refer to the Twiggy disks. Apple announced but never shipped the UniFile and DuoFile products, which were single and dual Twiggy drives for the Apple II and Apple III. The drives were only used in the original Lisa computer.

Apple also used the Twiggy drive in the early Macintosh prototypes, as shown in [this picture](#), courtesy of Joseph Liberto of VirtuosoDesign. By the time the Macintosh was introduced in 1984 they had switched to a Sony 400 KB single-sided 3.5 inch drive. While the Sony drive was custom-built to Apple specifications using the variable motor speed and motorized disk ejection, it used standard media and the standard track pitch of 135 TPI.

The Sony drive was so much more reliable than the Twiggy that Apple designed it into the Lisa 2, and offered a free upgrade from the Lisa 1 to the Lisa 2. Consequently the Lisa 1 has become quite a rarity.

I am interested in acquiring additional Twiggy diskettes and drives, new or used. If you have any, please email me at eric@brouhaha.com.

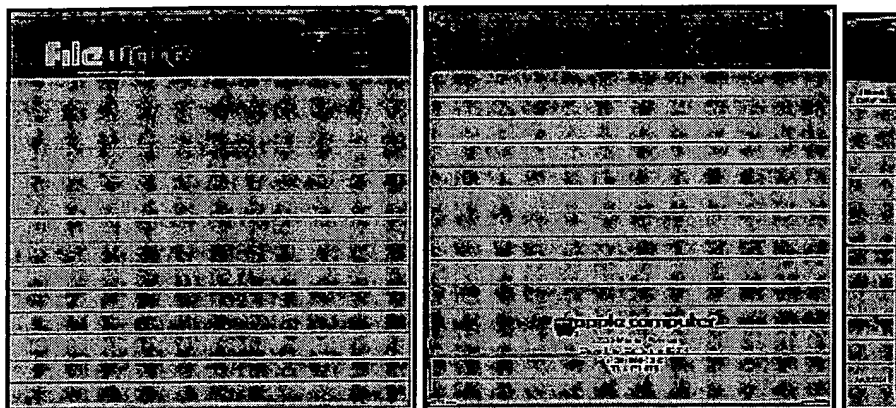
Below are images of Twiggy diskettes scanned at 35 pixels per inch. Each image is linked to a larger image scanned at 75 pixels per inch.

Unfortunately it is difficult to see the head and index holes in the diskette jackets. You may have to adjust your monitor.

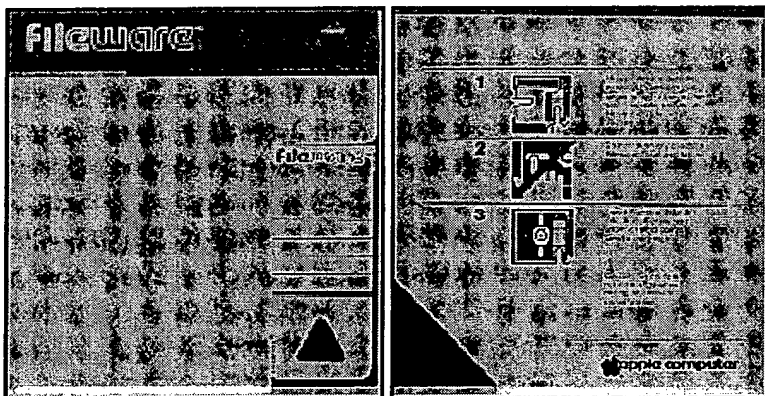
Apple FileWare diskettes

Apple Part Number A9D0001

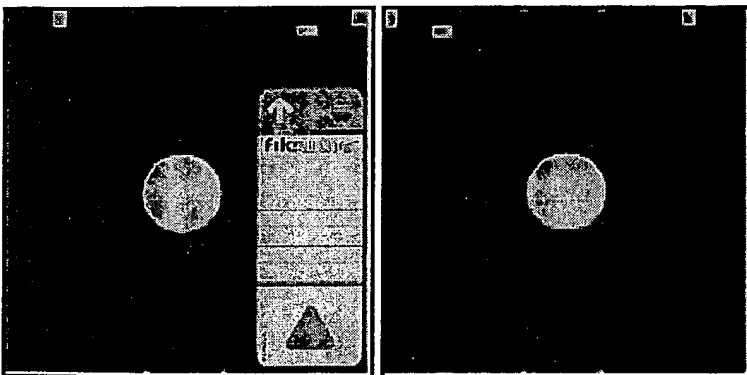
Box of five diskettes:



Diskette in sleeve:



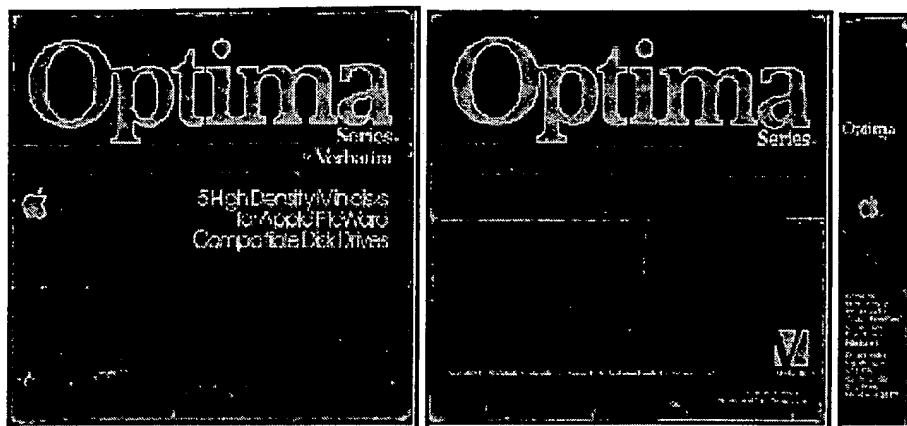
Diskette:



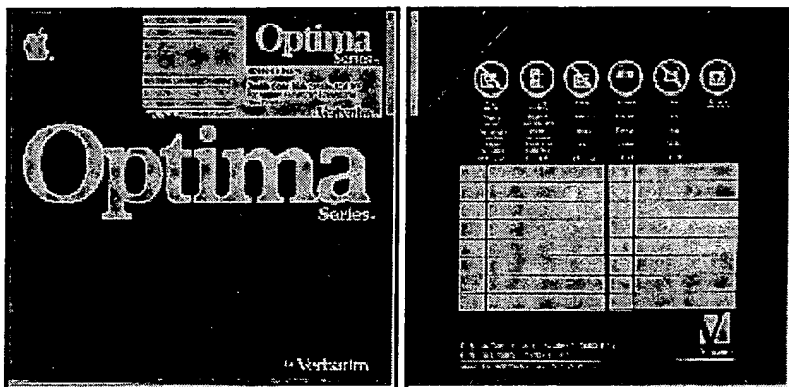
Verbatim Optima Series minidisks

Verbatim Reorder #26274

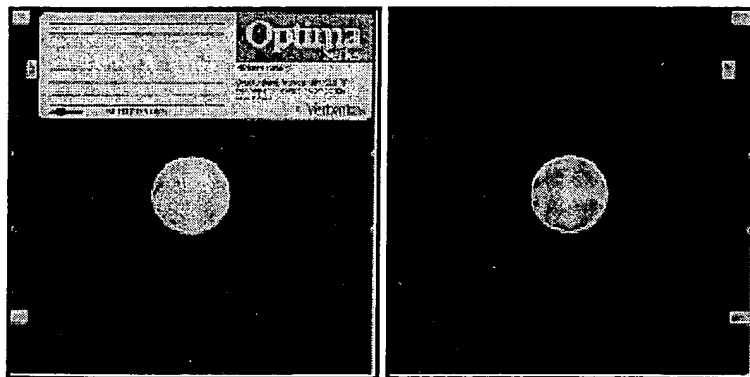
Box of five diskettes:



Diskette in sleeve:



Diskette:



Note how Apple oriented the labelling on the diskette and jacket such that the user could grasp the diskette with his or her thumb on the arrow, and insert it directly into the drive. Verbatim chose to label the diskettes and jackets such that the printing will be sideways when the diskette is inserted into the drive.



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